

What is claimed is:

1. A wireless communication system comprising:  
a plurality of base stations separated from each other by a predetermined distance along a traveling route of a vehicle and having respective communication areas; and

a terminal station carried by a vehicle for wireless communication with the base stations when entering the communication areas of the base stations,

wherein each communication area of the base stations is sized to cover generally only one vehicle to exist therein and the communication areas are separated from one another without overlapping.

2. The wireless communication system as in claim 1, wherein:  
the communication area has a greatest possible size which is incapable of covering a plurality of vehicles therein.

3. The wireless communication system as in claim 1, wherein:  
data is dividedly transmitted in the communication areas of the base stations existing along a traveling direction of the vehicle in case that transmission of the data to the terminal station is not completed within the communication area of each base station.

4. The wireless communication system as in claim 3, wherein:  
the terminal station includes data storage means for accumulating the data transmitted dividedly; and  
the data storage means has a data storage capacity which is more than a value  $R \times T$  which is a product of  $R$  and  $T$ ,  $R$  representing

playing data rate at the terminal station and  $T (= L / v)$  representing non-data transmission time determined by a velocity  $v$  at which the terminal station moves between adjacent communication areas divisionally transmitting the data and the distance  $L$  between the adjacent communication areas.

5. The wireless communication system as in claim 4, wherein:  
the number of communication areas of the base stations along the traveling route satisfies the following condition,

(condition) ...  $E \geq RaREQ / RaSA$

where  $E$  is an effective communication section ratio,  $RaREQ$  is a data transmission rate necessary for utilizing the data without interruption at the terminal station, and  $RaSA$  is the data transmission rate from the base station to the terminal station.

6. The wireless communication system as in claim 1, wherein:  
a width of the communication area of the base station in a widthwise direction of the traveling route is set based on a width of a traffic lane of the traveling route.

7. The wireless communication system as in claim 1, wherein:  
the traveling route includes a plurality of traffic lanes so that a plurality of vehicles can travel side by side; and  
a width of the communication area of the base station in a widthwise direction of the traveling route is set based on a width of one traffic lane.

8. The wireless communication system as in claim 7, wherein:  
the plurality of traffic lanes is directly adjacent to each other;  
and

the communication area is formed such that the communication areas for the plurality of traffic lanes are displaced in a traveling direction so as not to abut each other in a widthwise direction of the traveling route.

9. The wireless communication system as in claim 7, wherein:  
the plurality of traffic lanes is directly adjacent without any intervening things; and

the communication areas of the plurality of traffic lanes are adjacent each other along the widthwise direction of the traveling route, and are separated from each other by a predetermined width such that the adjacent communication areas do not interfere each other.

10. The wireless communication system as in claim 7, wherein:  
the base station transmits a carrier wave for forming the communication area from a certain direction such that it is not obstructed by vehicles moving on the traveling route or other structures on or around the traveling route.

11. The wireless communication system as in claim 10, wherein:  
the base station transmits the carrier wave from approximately right above the traffic lane.

12. The wireless communication system as in claim 1, wherein:  
the base station transmits the carrier wave for forming the communication area to an area where a frequency of the carrier wave received by the terminal station of the vehicle moving on the traveling route does not vary in discontinuity by means of Doppler effect.

13. The wireless communication system as in claim 1, wherein:  
the number of communication areas of the base stations on the traveling route is set to satisfy the following condition,

$$(\text{condition}) \dots E > 10^{\{-(GtSA-GtCN)/10\}}$$

where E is an effective communication section ratio, GtSA is an antenna gain of the base station and GtCN is an antenna gain of the base station of continuous access method in which the communication areas overlap with each other, with " $\wedge$ " in the above expression being the power of numeric value before " $\wedge$ " to the number of times of the numeric value after " $\wedge$ ".

14. The wireless communication system as in claim 1, wherein:  
the plurality of base stations is connected to one control station through optical transmission line and the control station is connected to a wire communication network at the outside;

the control station receives, in down-link direction, a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal and converting the base band signal into a high frequency signal, and thereafter modulates it to a light signal to transmit to the base station; and

the base station converts the light signal transmitted from the

control station into an electrical signal to extract the high frequency signal, and transmits the extracted high frequency signal to the terminal station.

15. Wireless communication system as in claim 1, wherein:

the plurality of base stations is connected to one control station through optical transmission line and the control station is connected to a wire communication network at the outside;

the control station receives, in down-link direction, a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal and converting the base band signal into an intermediate frequency signal, and thereafter modulates it to a light signal to transmit to the base station; and

the base station converts the light signal transmitted from the control station into an electrical signal to extract the intermediate frequency signal, converts the extracted intermediate frequency signal into a high frequency signal, and transmits the high frequency signal to the terminal station.

16. The wireless communication system as in claim 1, wherein:

the plurality of base stations is connected to one control station through optical transmission line and the control station is connected to a wire communication network at the outside;

the control station receives, in a down-link direction, a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal, and thereafter modulates it to a light signal to transmit to the base station;

and

the base station converts the light signal transmitted from the control station into an electrical signal to extract the base band signal, converts the extracted base band signal to a high frequency signal, and transmits the high frequency signal to the terminal station.

17. The wireless communication system as in claim 1, wherein:

the plurality of base stations is connected to one control station through an optical transmission line and the control station is connected to a wire communication network at an outside;

the base station, in an up-link direction, receives a high frequency signal transmitted from the terminal station and converts it to a light signal to transmit to the control station; and

the control station extracts the original high frequency signal from the transmitted light signal and converts the extracted high frequency signal to a wire communication signal and connects to the wire communication network at the outside.

18. The wireless communication system as in claim 1, wherein:

the plurality of base stations is connected to one control station through an optical transmission line and the control station is connected to a wire communication network at an outside;

the base station, in an up-link direction, receives a high frequency signal transmitted from the terminal station and converts the high frequency signal into an intermediate frequency signal and modulates the intermediate frequency signal to a light signal to transmit to the control station; and

the control station extracts the original intermediate frequency signal from the transmitted light signal and converts the extracted intermediate frequency signal to a wire communication signal and connects to the wire communication network at the outside.

19. The wireless communication system as in claim 1, wherein:

the plurality of base stations is connected to one control station through an optical transmission line and the control station is connected to a wire communication network at an outside;

the base station, in an up-link direction, receives a high frequency signal transmitted from the terminal station and converts the high frequency signal into a base band signal and converts the base band signal into a light signal to transmit to the control station; and

the control station extracts the original base band signal from the transmitted light signal and converts the extracted base band signal to a wire communication signal and connects to the wire communication network at the outside.

20. The wireless communication system as in claim 1, wherein:

the plurality of base stations are connected with the control station in a star type.

21. The wireless communication system as in claim 1, wherein:

the plurality of base stations are connected with the control station in a bus network type.

22. The wireless communication system as in claim 21, wherein:  
optical transmission between the plurality of base stations and the control station uses wavelength division multiplex type that multiplexes divisionally by differing wavelengths of a transmission light according to each base station.

23. The wireless communication system as in claim 1, wherein:  
the base station has an array antenna having a plurality of antenna elements.

24. The wireless communication system as in claim 1, wherein:  
the terminal station has an array antenna having a plurality of antenna elements.

25. A base station for wireless communication with a terminal station carried by a vehicle entering a communication area thereof, wherein:

the base station is separated from adjacent ones by a predetermined distance along a traveling route of the vehicle; and

the communication area of the base station is sized to cover generally only one vehicle to exist therein and the communication area is separated from communication areas of adjacent communication areas without overlapping.

26. The base station as in claim 25, wherein:  
the communication area has a greatest possible size which is incapable of covering a plurality of vehicles therein.



27. The base station as in claim 25, wherein:  
data is dividedly transmitted in the communication area of the base station existing along a traveling direction of the vehicle in case that transmission of the data to the terminal station is not completed within the communication area of each base station.

28. The base station as in claim 27, wherein:  
the number of communication areas of the base stations along the traveling route satisfies the following condition,  
(condition) ...  $E \geq \text{RaREQ} / \text{RaSA}$   
where E is an effective communication section ratio, RaREQ is a data transmission rate necessary for utilizing the data without interruption at the terminal station, and RaSA is the data transmission rate from the base station to the terminal station.

29. The base station as in claim 25, wherein:  
a width of the communication area of the base station in a widthwise direction of the traveling route is set based on a width of a traffic lane of the traveling route.

30. The base station as in claim 25, wherein:  
the traveling route includes a plurality of traffic lanes so that a plurality of vehicles can travel side by side; and  
a width of the communication area of the base station in a widthwise direction of the traveling route is set based on a width of one traffic lane.

31. The base station as in claim 30, wherein:  
the plurality of traffic lanes is directly adjacent to each other;  
and

the communication area is formed such that the communication areas for the plurality of traffic lanes are displaced in a traveling direction so as not to abut each other in a widthwise direction of the traveling route.

32. The base station as in claim 30, wherein:  
the plurality of traffic lanes is directly adjacent without any intervening things; and

the communication areas of the plurality of traffic lanes are adjacent each other along the widthwise direction of the traveling route, and are separated from each other by a predetermined width such that the adjacent communication areas do not interfere each other.

33. The base station as in claim 30, wherein:  
the base station transmits a carrier wave for forming the communication area from a certain direction such that it is not obstructed by vehicles moving on the traveling route or other structures on or around the traveling route.

34. The base station as in claim 33, wherein:  
the base station transmits the carrier wave from approximately right above the traffic lane.

35. The base station as in claim 25, wherein:

the base station transmits the carrier wave for forming the communication area to an area where a frequency of the carrier wave received by the terminal station of the vehicle moving on the traveling route does not vary in discontinuity by means of Doppler effect.

36. The base station as in claim 25, wherein:

the number of communication areas of the base stations on the traveling route is set to satisfy the following condition,

$$(\text{condition}) \dots E > 10^{\{-\text{GtSA}-\text{GtCN}\}/10\}}$$

where E is an effective communication section ratio, GtSA is an antenna gain of the base station and GtCN is an antenna gain of the base station of continuous access method in which the communication areas overlap with each other, with "<sup>^</sup>" in the above expression being the power of numeric value before "<sup>^</sup>" to the number of times of the numeric value after "<sup>^</sup>".

37. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which receives a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal and converting the base band signal into a high frequency signal, and thereafter modulates it to a light signal; and

the base station, in a down-link direction, converts the light signal transmitted from the control station into an electrical signal to extract the high frequency signal, and transmits the extracted high frequency signal

to the terminal station.

38. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which receives a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal to convert the base band signal into an intermediate frequency signal, and thereafter modulates it to a light signal; and

the base station, in a down-link direction, converts the light signal transmitted from the control station into an electrical signal to extract the intermediate frequency signal, converts the extracted intermediate frequency signal into a high frequency signal, and transmits the high frequency signal to the terminal station.

39. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which receives a wire communication signal addressed to the terminal station from an outside and generates a base band signal by converting the wire communication signal and thereafter modulates it to a light signal; and

the base station, in a down-link direction, converts the light signal transmitted from the control station into an electrical signal to extract the base band signal, converts the extracted base band signal to a high frequency signal, and transmits the high frequency signal to the terminal station.

40. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which extracts an original high frequency signal from a light signal and converts the extracted high frequency signal to a wire communication signal; and

the base station, in an up-link direction, receives the high frequency signal transmitted from the terminal station, converts the received high frequency signal to a light signal, and transmits the light signal to the control station.

41. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which extracts an original intermediate frequency signal from a light signal and converts the extracted intermediate frequency signal to a wire communication signal; and

the base station, in an up-link direction, receives a high frequency signal from the terminal station and converts the high frequency signal into an intermediate frequency signal and modulates the intermediate frequency signal to a light signal to transmit to the control station.

42. The base station as in claim 25, wherein:

the base station is connected through an optical transmission line to a control station, which extracts an original base band signal from a light signal and converts the extracted base band signal to a wire communication signal; and

the base station, in an up-link direction, receives a high frequency signal transmitted from the terminal station and converts the

high frequency signal into a base band signal and converts the base band signal into a light signal to transmit to the control station.

43. A terminal station carried by a vehicle for wireless communication with a plurality of base stations separated from each other by a predetermined distance along a traveling route of the vehicle and capable of divisionally receiving given data from the plurality of base stations, the terminal station comprising:

data storage means for accumulating the data transmitted divisionally from the base stations,

wherein the data storage means has a data storage capacity which is more than a value  $R \times T$  which is a product of  $R$  and  $T$ ,  $R$  representing a data rate used for transmission of the data at the terminal station and  $T (= L / v)$  representing non-data transmission time determined by a velocity  $v$  at which the terminal station moves between adjacent communication areas divisionally transmitting the data and the distance  $L$  between the adjacent communication areas.

44. A terminal station carried by a vehicle for wireless communication with base stations separated from each other by a predetermined distance along a traveling route of the vehicle, the terminal station comprising:

an antenna for transmitting a carrier wave which forms a communication area from approximately right above a traveling course of the vehicle,

wherein the antenna is mounted in the upper part of the vehicle.